19. Derive the complex potential for two dimensional irrational, incompressible flows.

20. Derive the Navier — stokes equation of a motion of a viscous fluid.

NOVEMBER/DECEMBER 2024

23PEMA35B — FLUID DYNAMICS

Time : Three hours Maximum : 75 marks

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SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Define Potential kind.
2. What is unsteady flow?
3. Explain Hydrostatic pressure.
4. What do you mean by conservative force?
5. Define simple sources.
6. What is doublets?
7. Define stream function.
8. State Milne- Thomson circle theorem
9. What do you mean by stress matrix?
10. Explain Principal stress.

SECTION B — (5 × 5 = 25 marks)

Answer ALL questions.

11. (a) Derive the velocity potential. To Show that in a steady flow ϕ represent equipotential curve.

Or

(b) For an incompressible fluid $q = [-\omega y, \omega x, 0]$ (ω = constant). Discuss the nature of the flow.

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12. (a) Prove that the pressure p at a point in a moving inviscid fluid is same in all direction

Or

(b) Derive the Bernoulli's equation.

13. (a) Discuss doublet in a uniform stream.

Or

(b) Find the velocity potential due to the doublet at 'o'.

14. (a) Explain the line doublets.

Or

(b) Find the equation of the stream lines due to a uniform line sources of strength m through the points $A(-c, 0)$, $B(c, 0)$ and a uniform line sink of strength 2 m through the origin.

15. (a) Explain the rate of strain quadratic and principal stress.

Or

(b) Express the six distinct components of the stress matrix of the principal stresses.

SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Show that the motion specified by $q = \frac{k^2(xj - yi)}{x^2 + y^2}$, k = constant is a possible motion for an incompressible fluid. If so, determine the equation of the stream lines. Also test whether the motion is the potential kind and so determine the velocity potential

17. Derive the Euler's equation of motion.

18. Doublets of strength μ_1, μ_2 are situated at points A_1, A_2 whose Cartesian coordinates are $(0,0,c_1)(0,0,c_2)$ their axes being directed towards and away from the origin respectively. Find the condition that there is no transport of fluid cover the surface of the sphere $x^2 + y^2 + z^2 = c_1 c_2$.